Performance Diagnostics

International® MaxxForce™ 5

Beginning with 2007 Model Year

Technician _____ Kilometers ____ Transmission _____ Ambient temperature _____ Engine SN _____ ECM calibration _____

Date _____ Miles _____ Manual ____ Auto _____ Coolant temperature _____ Engine HP _____ Injector No. _____

Hours _____

Unit No. _____ VIN _____ Truck build _____ Complaint _____ Engine Family Rating Code _____ Turbocharger No. _____

WARNING

To prevent personal injury or death, read all safety instructions in the "Safety information" section of *Diagnostics Manual* EGES-395 before doing procedures on this form.

Notes See "Performance Diagnostics" in EGES-395. Use figures and additional information to do each test or procedure. Record results on this form.

Do all checks in sequence unless otherwise stated. Doing a check or test out of sequence could cause incorrect results.

If a problem was found and corrected, **it is not necessary to complete the rest of the form** unless a performance concern remains.

See EGES-395 Appendix A for Performance Specifications and Appendix B for Diagnostic Trouble Codes (DTCs).

1. Visual Inspection

- ☐ Engine Oil Level.
- ☐ Fuel Level.
- ☐ Engine Coolant Level.
- ☐ Electrical System.
- ☐ Exhaust System.
- ☐ Intake Restriction (measure at high idle).

Check	Actual
Oil level	
Fuel level	
Coolant level	
Air filter restriction gauge or Gauge Bar Tool	

2. ECM Calibration and Diagnostic Trouble Codes

- ☐ Install Electronic Service Tool (EST).
- ☐ Record ECM calibration _____
- ☐ Use EST to read DTCs.

Active DTCs
Inactive DTCs

Correct problem causing active DTCs before continuing.

3. KOEO Standard Test

- ☐ Use EST to run KOEO Standard Test

DTCs

Correct problems causing DTCs before continuing.

4. KOEO Injector Test

- ☐ Use EST to run KOEO Injector Test.

DTCs

Correct problem causing DTCs before continuing.

5. Sensor Compare

- ☐ Use EST to check KOEO sensor values.

Sensor	Spec.	actual	Sensor	Spec.	actual
ECT			EBP		
EOT			EOP		
MAT			EGDP		
ICP			EGT1		
BAP			EGT2		
MAP			EGT3		

If sensor values are not within a reasonable range, see EGES-395 “Electronic Control System Diagnostics” section for diagnostic procedure.

6. KOER Standard Test

Note: Engine coolant temperature must be 70 °C (158 °F) or higher.

- ☐ Use EST to run KOER Standard Test.

DTCs

Correct problem causing active DTCs before continuing.

7. Torque Converter Stall (Automatic Only)

- ☐ Set parking brake and apply service brake.
- ☐ Put transmission in drive.
- ☐ Push accelerator to the floor, begin timing and monitor tachometer until tachometer stops moving.
- ☐ Record RPM and time.

Condition	Spec	Actual
Stall RPM		
Time (idle to stall in seconds)		

- If minimum RPM is reached within specified time, do not continue with performance diagnostics for a launch concern.
- If RPM is low, or was not reached within specified time, continue to next test.

8. Fuel Supply System

- ☐ Measure pressure at the secondary fuel filter housing test port, remove EFP switch for access.
- ☐ If no concerns are found in Pressure, Quality, and Aerated Fuel test, do not continue testing fuel system.

Pressure, Quality, and Aerated Fuel	Fuel in tank	Yes ☐ No ☐
	Hear FP running	Yes ☐ No ☐
First sample	Aerated fuel	Yes ☐ No ☐
	Contaminated fuel	Yes ☐ No ☐
Second sample (if needed)	Aerated fuel	Yes ☐ No ☐
	Contaminated fuel	Yes ☐ No ☐
	Fuel pressure KOEO	Spec Actual
	Fuel pressure low idle	Spec Actual
	Fuel pressure high idle	Spec Actual
Fuel Pump Discharge Pressure	Discharge pressure	Spec Actual
Fuel Pump Inlet Restriction	Restriction	Spec Actual

- If a hum can not be heard from the HFCM, verify fuel pump is being powered. Repair as necessary.
- If fuel has air bubbles, check for leaks in supply lines - tank to HFCM.
- If fuel is contaminated, correct problem.
- If fuel pressure is low or slow to build, replace both fuel filters and retest.
- If fuel pressure is still low or slow to build, do Fuel Pump Discharge Pressure test.
- If pump discharge pressure is in specification, inspect fuel regulator valve.
- If discharge pressure is low or slow to build, do Fuel Pump Inlet Restriction test.

9. Injection Control Pressure (ICP)

- ☐ Use EST to monitor ICP and engine speed.

Condition	Spec	Actual
Low idle		
High idle - Initial		
High idle - After 2 minutes		
Aerated oil Yes ☐ No ☐		

- If EOP is high or unstable, hold at high idle for 2 minutes. Return to low idle, take oil sample, check for foam. Fix problem if lube oil is aerated.
- If oil is not aerated, unplug ICP sensor and check for engine stability. If problem is corrected, see Operational Voltage checks for ICP sensor in EGES-395 “Diagnostic Control System Diagnostics” section. If ICP is still high or unstable, replace IPR and retest.

10. Boost Control

See EGES-395 Performance Specifications

Linkage movement (hand)	OK ☐	Not OK ☐
Linkage movement and pressure (pressure @ boost pressure tube)	Spec	Actual
Leaks	Yes ☐	No ☐
Run KOEO Output State Test High	Valve closed ☐	Valve open ☐
Linkage movement and pressure (pressure @ actuator)	OK ☐	Not OK ☐

Correct turbocharger or BCS problems before continuing.

11. EGR Valve Operation

- ☐ Run KOEO Output State Test Low.
- ☐ Enter Output State Test Low data.
- ☐ Run KOEO Output State Test High.
- ☐ Enter Output State Test High data.

Output State Test	EGR valve spec	EGR valve actual
Low		
High		

Check Performance Specifications and repair EGR problems before continuing.

12. Road Test (Full load, rated speed)

- ☐ Use EST to monitor MAP, ICP, rpm, EBP, and Engine Load %.

	Spec	Actual
MAP/boost		
ICP		
rpm	Rated speed	
EBP		
Engine Load (EL %)	100%	

13. Exhaust Restriction

- ☐ Use EST to open KOER Air Management session.
- ☐ Unplug EGR valve harness.
- ☐ Run engine at high idle.

	Spec	Actual
High Idle Exhaust Back Pressure		

If Actual is higher than Spec correct problem causing restriction before continuing.

14. Crankcase Pressure

- ☐ Measure at oil fill tube with crankcase pressure test adapter.
- ☐ Clamp off crankcase breather hose.
- ☐ Measure at high idle.

Instrument	Spec	Actual
Magnehelic gauge or Manometer		

15. Injector Disable

Use EST to run injector disable test to identify suspect cylinders.

Selected cylinder	EOT	Average fuel rate	Average Engine Load	rpm
1				
2				
3				
4				
5				
6				

If any cylinder is suspect, do Manual Compression Test.

16. Manual Compression Test

- ☐ Disconnect CKP or CMP sensor to disable engine starting.
- ☐ Remove left bank glow plug and install Compression Test Adapter and Cylinder Compression Gauge. Test cylinders individually.
- ☐ Turn ignition switch to ON. Crank at least 3 but no more than 4 times.
- ☐ Record pressure.
- ☐ Reinstall glow plug.
- ☐ Repeat procedure for all remaining cylinders.

Cylinder Compression	Pressure
Cylinder 1	
Cylinder 2	
Cylinder 3	
Cylinder 4	
Cylinder 5	
Cylinder 6	

If pressure difference is greater than 10 percent of each other, contact International® Technical Services at 1-800-336-4500 to start a case file.

Hard Start and No Start Diagnostics

International® MaxxForce™ 5

Beginning with 2007 Model Year

Technician _____ Kilometers _____ Transmission _____ Ambient temperature _____ Engine SN _____ ECM calibration _____

Date _____ Miles _____ Manual ____ Auto ____ Coolant temperature _____ Engine HP _____ Injector No. _____

Hours _____

Unit No. _____ VIN _____ Truck build _____ Complaint _____ Engine Family Rating Code _____ Turbocharger No. _____

WARNING

To prevent personal injury or death, read all safety instructions in the "Safety Information" section of International MaxxForce 5 *Diagnostics Manual* EGES-395 before doing procedures on this form.

Notes

See "Hard Start and No Start Diagnostics" in EGES-395. Use figures and additional information to do each test or procedure. Record results on this form.

For starting concerns with ECT temperatures below 16 ^{0}C (60 ^{0}F), do Glow Plug System and Inlet Air Heater System tests as necessary.

Do Required Test Procedures in sequence and do Special Test Procedures when needed. Doing a test out of sequence could cause incorrect results.

If a problem was found and corrected, **it is not necessary to complete the rest of the form** unless a starting concern remains.

See EGES-395 Appendix A for Performance Specifications and Appendix B for Diagnostic Trouble Codes (DTCs).

Required Test Procedures

1. Visual Inspection

- ☐ Engine Oil Level.
- ☐ Fuel Level.
- ☐ Engine Coolant Level.
- ☐ Electrical System.
- ☐ Exhaust System.
- ☐ Intake Air System and Charge Air Cooler (CAC).

Check	Actual
Oil level	
Fuel level	
Coolant level	
Air filter restriction gauge	

2. Initial Ignition Key On (Do not start)

- ☐ Check for WAIT TO START lamp
- ☐ Check amber WATER IN FUEL lamp
- ☐ Listen for injector precycle.
- ☐ Listen for hum or buzz from electronic fuel pump.

Comments

3. Engine Cranking

- ☐ Check cranking rpm. (Instrument panel)
- ☐ Check cranking battery voltage.

Check	Spec	Actual
Cranking rpm		
Cranking battery voltage	> 9 V	

4. ECM Calibration, DTCs, and Sensor Values

- ☐ Install Electronic Service Tool (EST).
- ☐ Record ECM calibration _____
- ☐ Use EST to read Diagnostic Trouble Codes (DTC).
- ☐ Use EST to check KOEO values for temperature and pressure sensors.

Active DTCs	
Inactive DTCs	
Abnormal sensor values Suspect sensor/value	☐ Yes ☐ No

Correct problems causing active DTCs and abnormal sensor values before continuing.

5. EST Data List

See International MaxxForce 5 *Diagnostic Manual* "Appendix A Performance Specifications"

- ☐ Enter data in the KOEO spec and Cranking spec columns.
- ☐ Monitor KOEO values and enter in KOEO actual column.
- ☐ Crank engine and monitor DATA for 20 seconds.
- ☐ Enter data in the Cranking actual column.

PID	KOEO spec	KOEO actual	Cranking spec	Cranking actual
VBAT				
RPM	0			
ICP				
EFP				
EGRP	0 %		0 %	

- If VBAT voltage is below spec, do Main Power Relay Voltage to ECM test.
- If no rpm is noted, check DTCs.
- If ICP is below spec, do Low ICP System Pressure test.
- If fuel pressure is low, do Fuel System test.
- If EGRP is out of spec, see EGDP Sensor in Section 7.

6.1 KOEO Standard Test

- ☐ Use EST to run KOEO Standard Test

Active DTCs

Correct problem causing active DTCs before continuing.

6.2 KOEO Injector Test

- ☐ Use EST to run KOEO Injector Test.

Active DTCs

Correct problem causing active DTCs before continuing.

Special Test Procedures

Fuel System

- ☐ Measure pressure at the secondary fuel filter housing test port. Remove EFP switch for access.
- ☐ If concerns were not found in Pressure, Quality, and Aerated Fuel test, do not continue testing fuel system.

Pressure, Quality, and Aerated Fuel	Fuel in tank	Yes ☐ No ☐
	Hear pump running	Yes ☐ No ☐
First sample	Aerated fuel	Yes ☐ No ☐
	Contaminated fuel	Yes ☐ No ☐
Second sample (if needed)	Aerated fuel	Yes ☐ No ☐
	Contaminated fuel	Yes ☐ No ☐
	Fuel pressure KOEO	Spec Actual
Fuel Pump Discharge Pressure	Discharge pressure	Spec Actual
Fuel Pump Inlet Restriction	Restriction	Spec Actual

- If a hum can not be heard from the HFCM, verify fuel pump is being powered. Repair as necessary.
- If fuel has air bubbles, check for leaks in supply lines - tank to HFCM.
- If fuel is contaminated, correct problem.
- If fuel pressure is low or slow to build, replace both fuel filters and retest.
- If fuel pressure is below specification, do Fuel Pump Discharge Pressure test.
- If pump discharge pressure is in specification, inspect fuel regulator valve.
- If discharge pressure is low or slow to build, do Fuel Inlet Restriction test.

Low ICP System Pressure

- ☐ Do the following tests, if ICP was not to spec during Test 5.
- ☐ Start and continue ICP System Function test, if lube oil pressure is above min spec and terminals on the IPR valve and engine harness are not damaged or corroded.
- ☐ If IPR connector pins are corroded, bent, or pushed back: **do not do remaining test procedures for Low ICP.**

Low ICP test	Question	Result
ICP System Function	IPR connectors: Corroded, bent or pushed back pins Over 3.45 Mpa (500 psi) (0.82V)?	☐ Yes ☐ No ☐ Yes ☐ No
IPR Function	Audible air leak?	Unplugged B+ applied ☐ Yes ☐ Yes ☐ No ☐ No
Under Valve Cover ICP Leaks	Audible air leak?	Cylinder Head Left Right ☐ Yes ☐ Yes ☐ No ☐ No Crankcase Left Right ☐ Yes ☐ Yes ☐ No ☐ No
Cylinder Head Isolation	Audible air leak?	Left Right ☐ Yes ☐ Yes ☐ No ☐ No
High-pressure Pump	Over 3.45 Mpa (500 psi) (0.82V)?	☐ Yes ☐ No

EGR Valve Operation

- ☐ Run KOEO Output State Test Low.
- ☐ Enter data from Output State Test Low.
- ☐ Run KOEO Output State Test High.
- ☐ Enter data from Output State Test High.

Output State Test	EGR valve spec	EGR valve actual
Low		
High		

Check Performance Specifications and repair EGR problems before continuing.

Main Power Relay Voltage to ECM

- ☐ Connect Main Power Relay Breakout Harness between the ECM main power relay and distribution box.
- ☐ Crank engine and use a DMM to measure voltage to ECM. (Min 130 rpm for 20 seconds)
- ☐ Check voltage between connector Pin 87 and ground.

Instrument	Spec	Actual
DMM	> 7 V	

Glow Plug System

- ☐ Use EST to do Output State Test for glow plugs. After 9 seconds, measure amperage and check for DTCs.
- ☐ If test results in Glow Plug System Amperage are within specification, **do not continue testing the glow plug system**.

Glow Plug System Amperage	Cylinder Head	Spec	Actual					
	Left	30-42 amps						
	Right	30-42 amps						
Glow Plug Harness to Ground Spec 0.1 - 6 ohms	Glow plugs L			Glow plugs R				
	1 Yellow	3 Red	5 White	2 Yellow	4 Red	6 White		
Glow Plug to Ground Spec 0.1 - 6 ohms								
Engine Harness 3-pin to Relay Spec < 5 ohms								
Relay Operation	Terminal	Spec	Actual					
	Battery feed	B+						
	Relay output	B+						

- If Glow Plug System Amperage readings are not within spec, do Glow Plug Harness to Ground test for all glow plugs out of spec.
- If results of Glow Plug System Amperage are 0 amps for both cylinder heads, do Relay Operation test.
- If results of Glow Plug Harness to Ground test are within spec, do test Engine Harness 3-pin to Relay.
- If results of Glow Plug Harness to Ground are not within spec, do Glow Plug to Ground test for all glow plugs out of spec.
- If results of Glow Plug to Ground test are within spec, replace failed glow plug harness. If results are not within spec, replace glow plugs that are out of spec.

Inlet Air Heater System

- ☐ Install Amp Clamp around feed wire and use EST to do Output State Test for Inlet Air Heater. After 4 seconds, measure amperage for heater wire.
- ☐ If Amperage draw test results are within specification, **do not continue testing the Inlet Air Heater System.**

Test	Air Heater Wire	
	Spec	Circuit
Amperage draw	45 to 70 Amps	
Voltage at Element	BAT V	
Resistance or Element	< 5 ohms	
Wiring harness continuity and resistance	< 5 ohms	
Relay operation Battery feed Relay output	 B+ B+	